HYDROMETEOROLOGICAL DESIGN STUDIES CENTER
QUARTERLY PROGRESS REPORT

1 January to 31 March 2016

National Water Center
National Weather Service
National Oceanic and Atmospheric Administration
U.S. Department of Commerce
Silver Spring, Maryland

April 2016

DISCLAIMER

The data and information presented in this report are provided only to demonstrate current progress on the various tasks associated with these projects. Values presented herein are NOT intended for any other use beyond the scope of this progress report. Anyone using any data or information presented in this report for any other purpose does so at their own risk.

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I. INTRODUCTION

The Hydrometeorological Design Studies Center (HDSC) within the National Water Center (formerly, Office of Hydrologic Development)[1] of the National Oceanic and Atmospheric Administration's (NOAA) National Weather Service (NWS) has been updating precipitation frequency estimates for various parts of the United States and affiliated territories. Updated precipitation frequency estimates for durations from 5 minutes to 60 days and average recurrence intervals between 1- and 1,000-years, accompanied by additional relevant information (e.g., 95% confidence limits, temporal distributions, seasonality) are published in NOAA Atlas 14. All NOAA Atlas 14 products and documents are available for download from the Precipitation Frequency Data Server (PFDS).

NOAA Atlas 14 is divided into volumes based on geographic sections of the country and affiliated territories. Figure 1 shows the states or territories associated with each of the Volumes of the Atlas. To date, we updated precipitation frequency estimates for Arizona, Nevada, New Mexico and Utah (Volume 1, 2004), Delaware, District of Columbia, Illinois, Indiana, Kentucky, Maryland, New Jersey, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, Virginia and West Virginia (Volume 2, 2004), Puerto Rico and U.S. Virgin Islands (Volume 3, 2006), Hawaiian Islands (Volume 4, 2009), Selected Pacific Islands (Volume 5, 2009), California (Volume 6, 2011), Alaska (Volume 7, 2011), Colorado, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Oklahoma, South Dakota, and Wisconsin (Volume 8, 2013), Alabama, Arkansas, Florida, Georgia, Louisiana, and Mississippi (Volume 9, 2013), and Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont (Volume 10, 2015). Since May 2015, HDSC has been working on updating precipitation frequency estimates for the state of Texas. They are expected to be published in mid-2018 in NOAA Atlas 14, Volume 11.

Funding for HDSC work comes from external sources. For recent volumes, most of the funds have come from the USACE, Federal Highway Administration (FHWA) and State Departments of Transportation with the funds flowing through the FHWA Transportation Pooled Fund Program, which is set up for different agencies to pool resources for common activities. This method allows for a single agreement between NWS with FHWA rather than many agreements with each entity providing funds. So far we have not been successful in putting together a coalition of funding sources for updating estimates for the remaining five northwestern states: Idaho, Montana, Oregon, Washington and Wyoming. For any inquiries regarding the status of this effort, please send an email to HDSC.questions@noaa.gov.

In FY15, due to funding issues, HDSC suspended activities on the following two projects: "Development of regional areal reduction factors to accompany NOAA Atlas 14 point precipitation frequency estimates." and "Analysis of potential impacts of climate change on precipitation frequency estimates." Consequently, we have omitted reporting on those two projects in the recent progress reports.

[1]As of April 1, 2015, the Office of Hydrologic Development reorganized into the National Water Center (NWC) with locations in Chanhassen, MN; Silver Spring MD; and Tuscaloosa, AL.

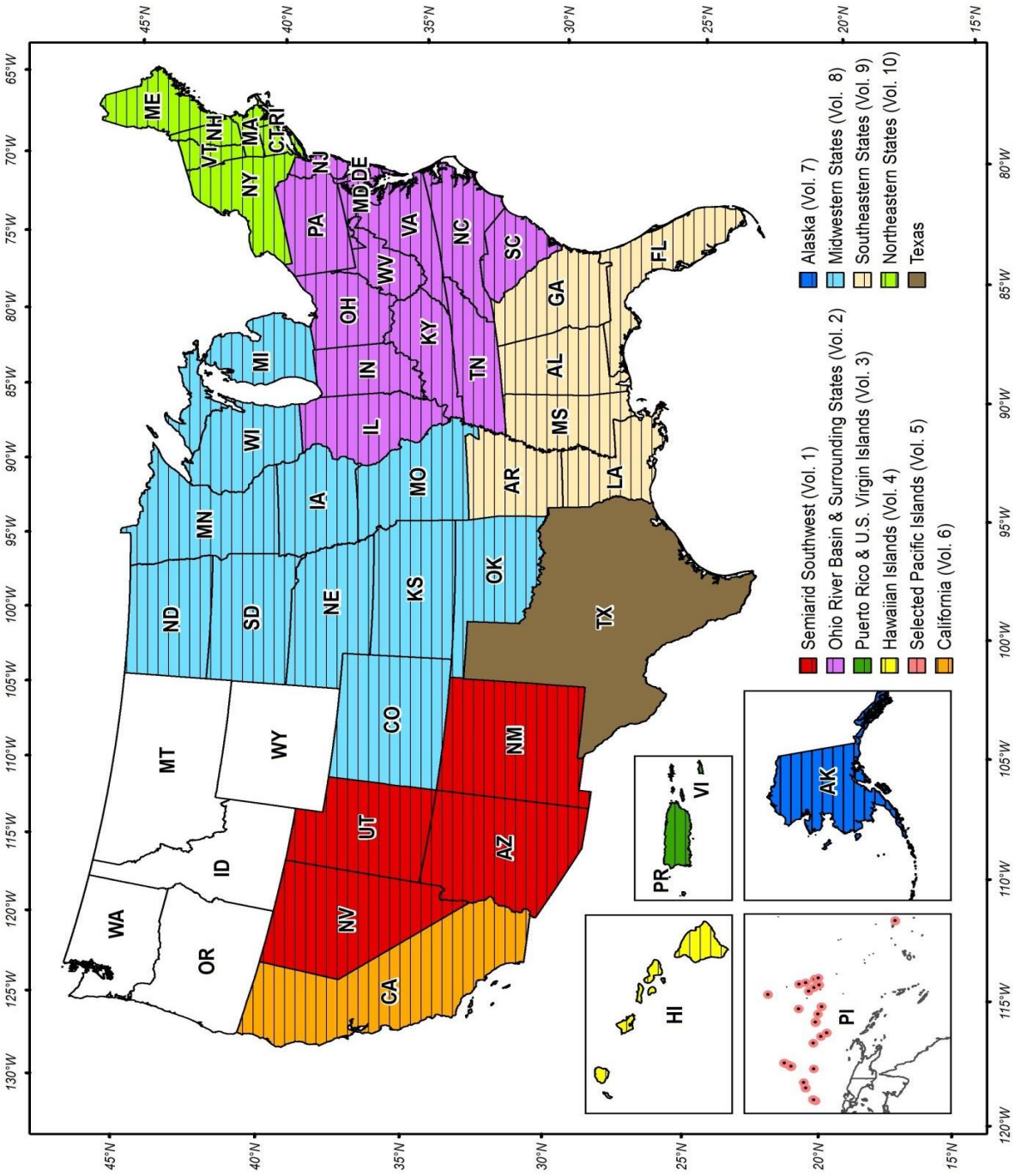

Figure 1. Current project area for Volume 11 (Texas) and project areas included in published Volumes 1 to 10.

II. CURRENT PROJECTS

1. PRECIPITATION FREQUENCY PROJECT FOR THE NORTHEASTERN STATES

1.1 PROGRESS IN THIS REPORTING PERIOD (Jan - Mar 2016)

Precipitation frequency estimates for the following seven northeastern states: Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island and Vermont were published on September 30th 2015, as NOAA Atlas 14 Volume 10. They are available for any location in the project area in a variety of formats through the Precipitation Frequency Data Server (PFDS) at http://hdsc.nws.noaa.gov/hdsc/pfds (via a point-and-click interface).

Additional results and information available there include:

- ASCII grids of partial duration series-based and annual maximum series-based precipitation frequency estimates and related confidence limits for a range of durations and frequencies with associated Federal Geographic Data Committee-compliant metadata;
- cartographic maps of partial duration series-based precipitation frequency estimates for selected frequencies and durations;
- quality controlled annual maximum series for all observing locations in the project area;
- temporal distributions;
- seasonality analysis.

Cartographic maps were created to serve as visual aids and are not recommended for estimating precipitation frequency estimates. Users are advised to take advantage of the PFDS interface or the downloadable underlying ASCII grids for obtaining precipitation frequency estimates.

Work on documentation describing the station metadata, data, and project methodology has ceased in October 2015 due to some funding issues. Those issues have just been resolved and we expect that NOAA Atlas 14 Volume 10 document will be published by the end of the next reporting period.

1.2 PROJECTED ACTIVITIES FOR THE NEXT REPORTING PERIOD (Apr - Jun 2016)

In the next reporting period, we will work on the documentation and publish it online (http://www.nws.noaa.gov/oh/hdsc/relevant_publications.html#1_section).

1.3 PROJECT SCHEDULE

Data collection, formatting, and initial quality control [Complete]

Extraction of annual maximum series (AMS); additional quality control and data reliability tests (e.g., outliers, independence, consistency across durations, duplicate stations, candidates for merging) [Complete]

Regionalization and frequency analysis [Complete]

Initial spatial interpolation of precipitation frequency (PF) estimates and consistency checks across durations [Complete]

Peer review [Complete]

Revision of PF estimates [Complete]

Remaining tasks (e.g., development of gridded precipitation frequency estimates, confidence intervals, development of PFDS web pages) [Complete]

Web publication of estimates [Complete]

Web publication of Volume 10 document [June 2016]

2. PRECIPITATION FREQUENCY PROJECT FOR TEXAS

2.1 PROGRESS IN THIS REPORTING PERIOD (Jan - Mar 2016)

NOAA Atlas 14, Volume 11 precipitation frequency project includes the state of Texas and approximately a 1-degree buffer around this state (Figure 2). This project began in May 2015 and is expected to be completed in mid-2018.

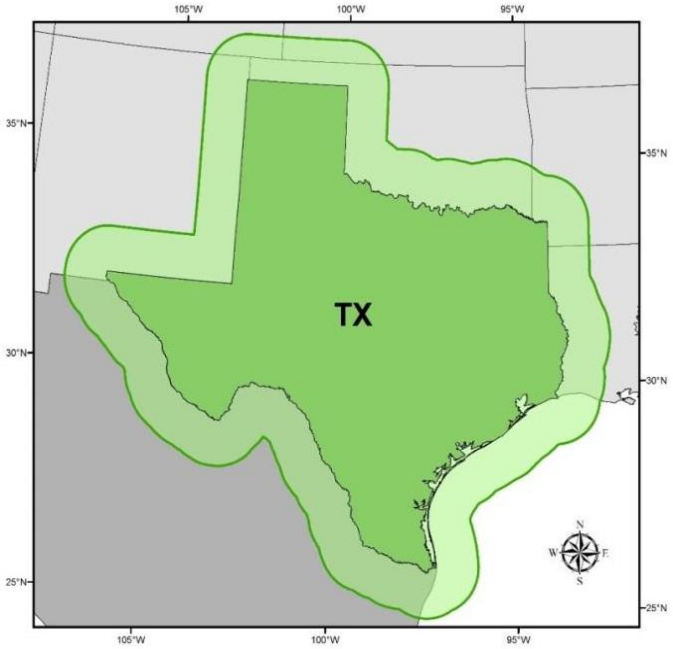

Figure 2. NOAA Atlas 14, Volume 11 extended project area (shown in green).

2.1.1. Data collection and formatting

The primary source of data for NOAA Atlas 14 Volumes is the NOAA's National Centers for Environmental Information (NCEI), but it is recognized that the NCEI's precipitation data may not be sufficient to accomplish the objectives of NOAA Atlas 14. For this project area, we are trying to get precipitation data (daily, hourly, 5-minute, etc.) for stations in Texas, as well as in adjacent portions of neighboring states (Arkansas, Louisiana, New Mexico, and Oklahoma) and also in Mexico collected by Federal, State and local agencies.

In early 2015, we asked our partners for assistance with the data. During this reporting period, we continued reviewing the data that was provided to us. We contacted other agencies which were indicated to us as additional sources of potentially useful data. We also continued work on formatting collected data into a common format. The status of data collection and formatting is shown in Table 1. The table contains information on agency that provided the data with dataset/network name (when available), with a brief comment on status of collection and formatting task. Generally, datasets indicated as "not used" contain information already included in another dataset, or data were assessed as not reliable for this specific purpose, or the dataset contains only stations with very short period of record.

We would like to thank all of those who responded to our inquiry and/or provided the data. We welcome any information on the data for this project area and we ask for help with collecting the data from datasets indicated as "need contact information". If you have any relevant information, please contact us at HDSC.Questions@noaa.gov.

Table 1. Status of data collection and formatting.

Source of data and dataset/network name (when available)	Comment
NCEI - Automated Surface Observing System (ASOS)	formatted
NCEI - Automated Weather Observing System (AWOS)	formatted
NCEI - DSI 3260 (15-minute precipitation)	formatted
NCEI - DSI 3240 (hourly precipitation)	formatted
NCEI - U.S. Climate Reference Network (USCRN)	formatted
NCEI - Global Historical Climatology Network (GHCN) Daily	formatted
NCEI - Quality Controlled Local Climatological Data (QCLCD)	formatted
NCEI - Unedited Local Climatological Data (ULCD)	formatted
Remote Automatic Weather Stations (RAWS)	formatted
Oklahoma Mesonet Observation Network	formatted
Climate Database Modernization Program - 19th Century Forts and Voluntary Observers Database Build Project (FORTS)	formatting in progress
National Atmospheric Deposition Program (NADP)	formatting in progress
USDA NRCS Soil Climate Analysis Network (SCAN)	formatting in progress
Texas Commission on Environmental Quality (TCEQ) Air Quality Network	formatting in progress
Tarrant Regional Water District (Greater Fort Worth area)/Tarrant County Urban Flood Control Network	formatting in progress
West Texas Mesonet	formatting in progress
Titus County Fresh Water Supply District No. 1	formatting in progress
Servicio Meteorologico Nacional, CONAQUA, Mexico	formatting in progress
National Estuarine Research Reserve System (NERRS)	formatting in progress
Sabine River Authority Precipitation Data	formatting in progress
Harris County Flood Control District's Flood Warning System	waiting for data
Lower Colorado River Authority Regional Met. Network (LCRA)	waiting for data
Jefferson County Drainage District 6 ALERT Precipitation and Stream Level Network	waiting for data
Texas Water Development Board	Waiting for data
Edwards Aquifer Authority	contacted with data request
Guadalupe-Blanco River Authority	contacted with data request
San Antonio River Authority	contacted with data request
City of Austin ALERT Network	need contact information
City of Dallas ALERT Network	need contact information
Texas Evapotranspiration Network	need contact information
Lavaca/Navidad River Authority Gage Network	need contact information
Northeast Texas Municipal Water District (NETMWD)	not used
Road Weather Information System (RWIS)	not used
Bexar County Urban Flood Control Network	not used

Meteorological Assimilation Data Ingest System (MADIS)	not used
United States Geological Survey	not used
Union Pacific Railroad Weather Station Network	not used
City of Houston	not used

2.1.2. Data digitization

We started a process of digitizing additional precipitation data that are available as scanned observation forms. We try to digitize stations in data-sparse areas, or for stations that have significant un-digitized data records. The main focus of the digitization effort will be on pre-1940 hourly precipitation data for 16 stations across Texas. The data was tabulated under the Work Projects Administration (WPA), during the Great Depression. This data comes from the NCEI's Climate Database Modernization Program (CDMP), through the NCEI-developed Environmental Document Access and Display System, Version 2 (EV2) application. Stations digitized during this reporting period are in Table 2.

Table 2. Digitized stations

Station name	Data Type	Period of Record
Taylor, TX	Hourly	1903-1932
Fort Worth, TX	Hourly	1903-1940
Fort Clark, TX	Daily	1852-1899

2.1.3 Adding missing significant events to precipitation records

Precipitation frequency estimates could potentially be significantly affected by incomplete records, particularly if the top events are missing in the records. The most common reasons for missing events are due to the rain gauge overflowing or being destroyed during an event, or due to data never having been archived, digitized, or were lost over time. Less often, the event amounts are misread from the observation forms, or the station was discontinued. In all of these cases, if the significant event was well documented in the journal publications, or was recorded at the nearby stations (usually within 5 miles), then we add it back to the station record. Some examples of significant missing events that were identified so far:

Table 3. Significant events missing in stations' records

Station name	Amount	Date
Cheapside	18 in/day	August 31,1981
Fort Clark	18 in/day	June 14-15, 1899
Taylor	23.11 in/day	Sept. 9, 1921
Hearne	30-40 in/day	June 30, 1899
Medina	30-40 in/day	August 2-3, 1978

2.1.3. Metadata quality control

We continued screening stations' metadata for errors. Stations with potential errors were identified by reviewing published coordinates and elevations for large changes over the course of the station's lifetime. Stations with assigned elevations that were more than 100 feet different

from elevations extracted from a 10-m digital elevation model (DEM) were investigated. Such stations may be re-located based on inspection of satellite images, maps and records of the station's history. Misplacements were typically the result of latitude and longitude data having inadequate precision. Original and revised coordinates for all stations used in the analysis will be provided in Appendix 1 of the accompanying NOAA Atlas 14 Volume 11 document. Stations with no elevation information were assigned DEM elevations.

2.2 PROJECTED ACTIVITIES FOR THE NEXT REPORTING PERIOD (Apr - Jun 2016)

We will continue with data collection, reformatting, digitization and station metadata checks. We'll aggregate data across all durations up to 60 days and extract annual maximum series for all stations and durations.

2.3 PROJECT SCHEDULE

Data collection, formatting, and initial quality control [April 2016]

Extraction of annual maximum series (AMS); additional quality control and data reliability tests (e.g., outliers, independence, consistency across durations, duplicate stations, candidates for merging) [January 2017]

Regionalization and frequency analysis [March 2017]

Initial spatial interpolation of precipitation frequency (PF) estimates and consistency checks across durations [June 2017]

Peer review [August 2017]

Revision of PF estimates [January 2018]

Remaining tasks (e.g., development of precipitation frequency estimates for partial duration series, seasonality, temporal distributions, documentation) [March 2018]

Web publication [April 2018]

III. OTHER

1. AEP ANALYSIS FOR THE MARCH 2016 LOWER MISSISSIPPI RIVER VALLEY STORM

Four-day rainfall totals near two feet caused devastating flooding in parts of Louisiana, Texas, and Mississippi in mid-March 2016. Rainfall totals from March 8-12, 2016, ranged from 12 inches of rain at Shreveport Regional Airport to 21.08 inches in Monroe, LA, and 23.33 inches in Swartz, LA. In neighboring Texas, up to 18 inches fell in Hemphill in Sabine county. To blame was a seemingly never-ending stream of moisture straight out of the tropics. The resultant flooding led to a state of emergency declaration for the entire state of Louisiana as many roads, including two major interstate highways, were closed, damaged, or destroyed. (https://www.climate.gov/news-features/event-tracker/maya-express-behind-gulf-coast-soaking).

HDSC analyzed annual exceedance probabilities (AEPs) for this storm. The AEP is the probability of exceeding a given amount of rainfall at least once in any given year at a given location. It is an indicator of the rarity of rainfall amounts and is used as the basis of hydrologic design. The underlying data for the AEP analyses were rainfall observations and point rainfall frequency estimates for a range of durations and frequencies. Rainfall data at 4km grid resolution came from the 6-hour National Centers for Environmental Prediction (NCEP), Environmental Modeling Center's (EMC) Stage IV analysis dataset. Rainfall frequency estimates are from NOAA Atlas 14 Volume 9 30 arc-sec ASCII grids (http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_gis.html)

We looked at several durations and created a map for 48-hour duration that showed the lowest AEPs for the largest area (Figure 3). This map does not represent isohyets at any particular point in time, but rather 48-hour isolines of AEPs within the whole 4-day event. The map is also available for download from the following page: http://www.nws.noaa.gov/oh/hdsc/aep_storm_analysis/

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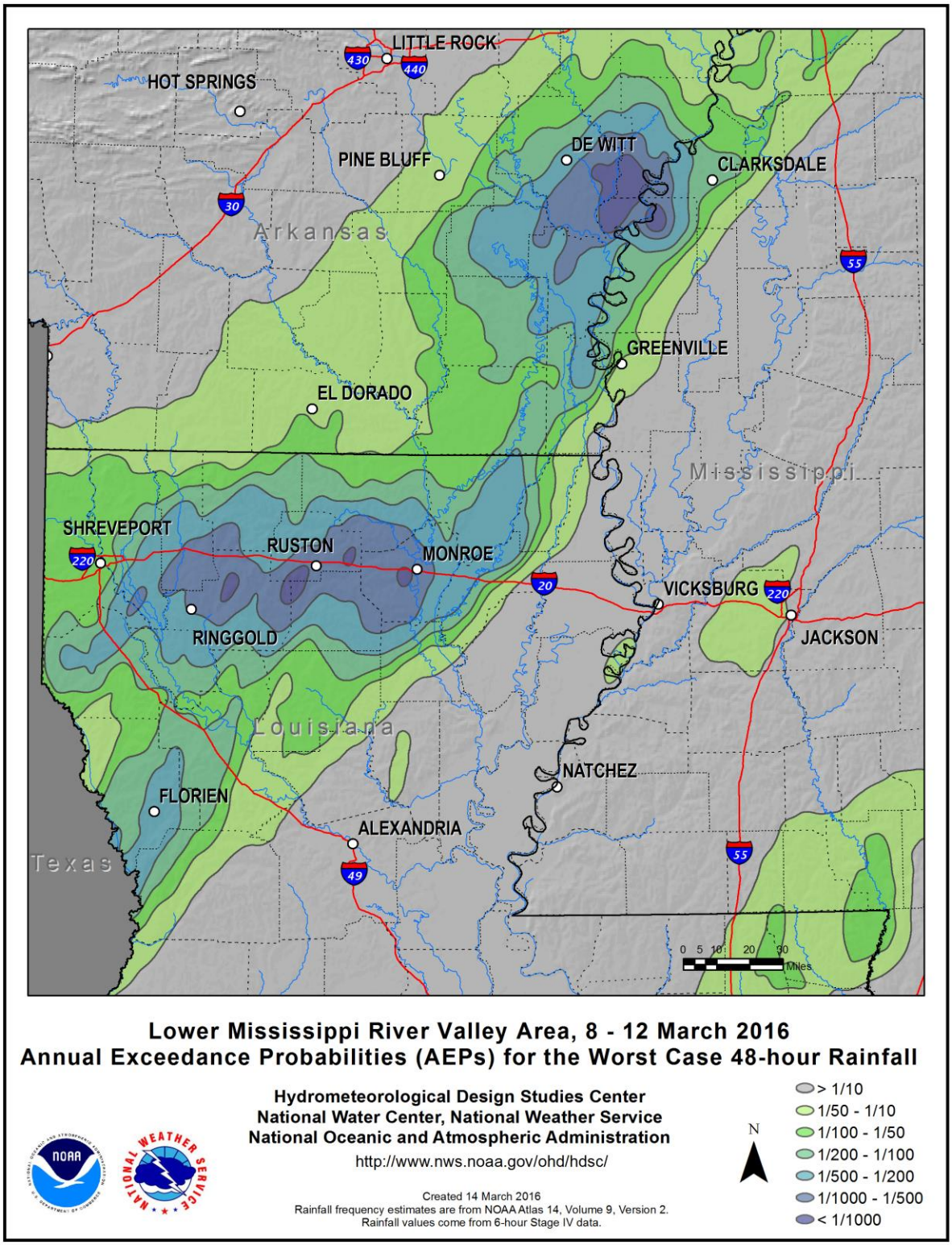

Figure 3. Annual exceedance probabilities for the worst case 48-hour rainfall in the Lower Mississippi River Valley area from 8 to 12 March 2016.

2. CONFERENCES, MEETINGS

On January 13, 2016, Dr. Sanja Perica gave a presentation entitled “Impact of Non-stationary Climate Conditions on Extreme Precipitation Frequency Estimates Needed for Engineering Design” (with co-authors M. St. Laurent, S. Pavlovic, C. Trypaluk, D. Unruh, and O. Wilhite) at the American Meteorological Society 96th Annual Meeting in New Orleans, LA.

On March 5, HDSC group member Sandra Pavlovic, gave a presentation at the Massachusetts Association of Conservation Commissions’ Annual Environmental Conference at Holy Cross College in Worcester, Massachusetts on recently published NOAA Atlas 14 Volume 10 update for the Northeast and on comparison between NOAA Atlas 14 Volume 10 estimates with corresponding estimates prepared by the Northeast Regional Climate Center.